DOCUMENT RESUME

ED 466 213 IR 021 284

AUTHOR Sethi, Parvinder S.; Newbill, Phyllis Leary

TITLE Infusing Interactive, Multimedia CD-ROM Technology into the First-Year College-Level Geology Curriculum: Recent Examples from Radford University, United States.

PUB DATE 2001-00-00

NOTE 7p.; In: ED-Media 2001 World Conference on Educational Multimedia, Hypermedia & Telecommunications. Proceedings (13th, Tampere, Finland, June 25-30, 2001); see IR 021 194.

AVAILABLE FROM Association for the Advancement of Computing in Education (AACE), P.O. Box 2966, Charlottesville, VA 22902 ($40, AACE members; $50, nonmembers). Tel: 804-973-3987; Fax: 804-978-7449; Web site: http://www.aace.org.

PUB TYPE Reports - Research (143) -- Speeches/Meeting Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.

DESCRIPTORS Comparative Analysis; Computer Assisted Instruction; *Computer Software Development; Educational Technology; Geology; High Schools; Higher Education; *Instructional Materials; Multimedia Materials; *Optical Data Disks; Technology Integration

ABSTRACT

In recent years, several CD-ROM-based instructional technology applications have been developed for use in both high school and college level classrooms. As multimedia authoring techniques evolve as important tools for teaching, it is imperative that teachers and multimedia authors understand the importance of focusing on specifically how the CD-ROM product will be used. The concept, functionality, and type of user interface of such applications must be driven by a clear understanding of the specific manner(s) in which they are intended to be used. In this paper, a comparative study is presented of two different types of CD-ROMs in terms of their design and use. Both CD-ROMs were recently produced for use at the college level. The "EarthShow" CD-ROM is intended for use as a presentation manager, whereby a teacher can seamlessly integrate images, audio, video, and animation for communicating information in a sensory-saturated manner. The "Groundwater Pollution" CD-ROM is a self-study tool, characterized by situation-based learning with practice and feedback features, and is designed for use by a learner on an individual, unsupervised basis. (Contains 18 references.) (Author/AEF)

Reproductions supplied by EDRS are the best that can be made
from the original document.

Infusing Interactive, Multimedia CD-ROM Technology into the First-Year College-level Geology Curriculum: Recent Examples from Radford University, United States

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY

G.H. Marks

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

1

Parvinder S. Sethi
Department of Geology, Reed Hall, Box 6939
Radford University, Radford, Virginia, VA 24142-6939
United States
psethi@radford.edu

Phyllis Leary Newbill
Department of Geology, Reed Hall, Box 6939
Radford University, Radford, Virginia, VA 24142-6939
United States
pnewbill@radford.edu

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
4 This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

ED 466 213

Abstract: In recent years, several CD-ROM-based, instructional technology applications have been developed for use in both high school and college-level classrooms. As multimedia authoring techniques evolve as important tools for teaching, it is imperative that teachers and multimedia authors understand the importance of focusing on specifically how the CD-ROM product will be used. The concept, functionality and type of user-interface of such applications must be driven by a clear understanding of the specific manner(s) in which they are intended for use. In this paper we present a comparative study of two different types of CD-ROMs in terms of their design and use. Both CD-ROMs were recently produced for use at the college level. The "EarthShow" CD-ROM is intended for use as a 'presentation manager' whereby a teacher can seamlessly integrate images, audio, video and animation for communicating information in a sensory-saturated manner. On the other hand, the "Groundwater Pollution" CD-ROM is a self-study tool, characterized by 'situation-based learning' with practice and feedback features and designed for use by a learner on an individual, unsupervised basis.

Introduction

In recent years a significant number of educational multimedia applications have been created for use both at the high-school and college levels (Wheeless-Gore, 1997, Williams et al. 1997, Sethi, 1998). In particular, educators have become increasingly sensitive to the diversity of learner styles among students and therefore have sought ways to communicate content more effectively (Gardner, 1983, 1993, Lazear, 1991, Armstrong, 1994, Herrington and Oliver, 1997, Butler and Lamberson, 1998). A number of both web-based and stand-alone CD-ROM-based multimedia applications have been produced for use in the teaching/learning of geoscience subjects (Prothero, 1996, Steele et al., 1997, Powell, 2000). Several teaching/learning modules have been created specifically for use in General Education courses (such as for first-year, non-science major students); examples include the work by Levine, 1998, and Saini-Eidukat et al. 1998. Examples of multimedia applications for teaching specifically the upper-level geology courses include the work of Rigsby, 1998, and Sharma and Hardcastle, 1999. In addition, attention is being directed towards making such multimedia material accessible for students with disabilities (Grogger, 1999).

Often however, there seem to be disconcerting gaps between design and actual manner/mode of use of such applications across a variety of teaching and learning environments. Such discordance in the design and creation process invariably leads to failure and/or low success rates of otherwise robust educational applications. It becomes imperative, therefore, that the entire design and development process of a multimedia teaching/learning tool be tempered by sensitivity to the manner(s) in which it is intended for use.

In this paper, we present a comparative analysis of two rather different multimedia CD-ROMs, both

IR021284

BEST COPY AVAILABLE

of which were designed for use by students in the introductory-level geoscience courses in college. One of the CD-ROMs, titled *EarthShow* was designed wholly as a "presentation manager" intended for use by an instructor in a group setting and all aspects of the design and functionality of this CD-ROM are in coherence with its intended use. The second CD-ROM, titled – *Groundwater Quality Issues for the Future Decision-Maker*, is a one-on-one, situation-based, learning application that is firmly rooted in recent models of multiple intelligence types (sensu Gardner, 1983) in learners. In addition, a strong emphasis is placed on determination of learner outcomes via practice sessions and feedback opportunities to help assess success or failure of a specific interactive learning session.

This paper will focus on two issues: 1) the importance of rooting interactive, multimedia applications on established models of learner styles and learning psychology, and 2) a presentation and analysis of some of the key interactive, multimedia screens from both of the aforementioned CD-ROMs.

Models of Learning Styles as a Basis for Designing Multimedia Applications

Howard Gardner's revolutionary work on recognizing multiple intelligence types in learners (Gardner, 1983, 1993) can provide for a logical and a firm footing for design and use of interactive, multimedia applications. Insofar as Gardner's multiple intelligence (MI) theory highlights a total of eight basic intelligence types in learners, it forces teachers to ask a fundamental question: *"Is my teaching style reaching out to the diversity of intelligences in the classroom?"* Another relevant question that needs to be answered is, *"Is my teaching strategy/technique/tool most effective in catering to different learner styles in my students or is there a better way?"* An interactive, multimedia application such as on a CD-ROM or on the internet represents a very powerful medium for delivery of information. Content can be communicated as a variety of sensory stimuli, including images, sounds, video clips, animations and interactive feedback. Advances in processor speeds and storage capacities of digital media including CD-ROMs have enabled teachers to store and access information of different types such as graphics, sounds, and text, from a single platform such as the internet, CD-ROMs, or DVD-ROMs. In other words, once a teacher has digitized and stored any combination of images, audio files, video clips and animation files on a web site, CD-ROM, or a DVD-ROM, he/she no longer has to worry about having access to outdated audio-visual devices such as slide projectors, laser-disc players, tape players, and/or video cassette players. A single CD-ROM, for instance, can be accessed in real-time, for sharing information in a truly multimedia and a seamless, interactive format thereby engaging most, if not all students in a learning environment.

Ongoing results of our assessment concerning the effectiveness of such media-intensive, interactive teaching/learning CD-ROMs show that on average, students respond better to use of such delivery methods. It is likely, therefore, that increasing numbers of educators will adopt and adapt such multimedia tools for communication of content both in and out of classrooms in the near future and in a variety of disciplines.

The other significant issue centers on the need for all multimedia authors to clarify the exact manner in which a particular multimedia application will be used be it in a classroom setting or on an individual, self-study basis. In this paper we discuss a variety of pedagogical features that have been built into the design and functionality of the two CD-ROMs for teaching and learning physical geology and environmental geology. It is hoped that sharing of the design strategies and of examples of types of use will provide a model for other teachers seeking to find examples for adaptation for creation of multimedia applications for teaching their own specific disciplines.

The Earth-Show CD-ROM

The EarthShow CD-ROM was designed for use as a presentation manager for introductory-level courses in physical geology and earth science. This CD-ROM was designed via story-boards at the Department of Geology at Radford University. Creation, testing and publishing were done by a reputed publishing company (Prentice Hall) in 2000. This CD-ROM was developed to accompany a specific physical geology text (*Foundations of Earth Science* by Lutgens and Tarbuck, 2000). Illustrations and images contained in the textbook and the CD-ROM were closely tied together. The CD-ROM chapters followed the same sequence of information as was presented in the textbook. Such a relationship was deemed critical in

helping students feel that the CD-ROM was a natural extension or a supplement of their specific textbook.

In terms of use, the EarthShow CD-ROM is designed for a lucid, seamless, fast access and presentation of a variety of media for teaching and learning physical geology. In addition to quick and non-internet dependent access to images, videos, sounds and text, a number of pedagogical strategies were utilized in the CD-ROM. The following section explains some of the key design features of this CD-ROM.

The *Main Screen* consists of a total of seventeen hyper-linked buttons in addition to buttons for actions/events such as Quit, Help, Sound level, Back by One Screen, and Forward by One Screen. A user can choose and explore any of the seventeen chapters by simply clicking on the appropriate button. Each chapter's opener screen consists of a variety of multimedia features that are kept consistent in all chapters. For example, The *Slide Show* feature appears on the opening screen of each of the seventeen chapters. A user can click on the slide show icon to view the slide show. A slide show consists of a series of aesthetic and content-oriented images that are set to a contemporary, unobtrusive sound track. The user can set the volume of sound via an easily accessible icon on each screen. Images in a slide show are derived from both the accompanying text and other sources so that students have the choice of studying images that are from outside the text but relevant to the text.

Each of the seventeen chapters also have an *Image Viewer* integrated into each one of them. Most text entries have small, quick-loading thumbnail images that can be accessed easily for reinforcement of content. Some text entries have several images linked to them, and users have the option of viewing some or all of the images at their own pace via buttons on the screen. Each image is accompanied by a detailed caption that ties the visual content with textual content of the chapter. A key assessment feature of this CD-ROM is the *Self-Quiz* that accompanies each chapter. A user can study an image, diagram, or any type of an illustration and try to identify labels or other text-based information that are shown as blank spaces (as exemplified in Figure 1).

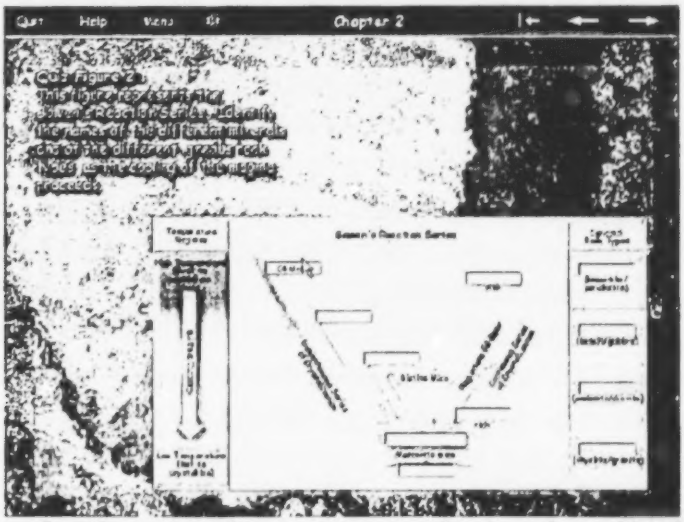

Figure 1: Illustration of a self-quiz screen from the chapter on rocks. A user has to think about the terms contained in the blank rectangular fields. The user can find out the correct answer by simply moving the cursor over a blank label as shown for the first blank field towards the middle of this screen (Olivine being the correct answer for that field).

To find the correct answer, a user simply moves the mouse over a blank field and the answer pops up in the field. The programmed answer disappears as soon as the mouse is moved away from the label. Figure 1 shows an example of such a Self-Quiz feature. From an authoring/programming perspective, such a blanks-based quiz can be constructed to cover almost any kind of subject matter. For example, applications of such self-assessment can easily be imagined for disciplines as diverse as architecture, biology, anatomy, chemistry and geography among others. In addition, such assessment techniques can lend themselves elegantly to a

variety of situation-based learning and training settings, ranging from a primer on identifying parts of an aircraft's cockpit to the components of a PCB (printed circuit board) in a computer manufacturing plant and so on.

The Groundwater Pollution CD-ROM

The groundwater pollution CD-ROM, *Groundwater Quality Issues for the Future Decision-Maker*, is intended for individual use by college freshmen enrolled in environmental geology or environmental science classes. Although a number of educators have integrated aspects of pollution in the introductory-level geology courses for non-science majors, there are distinct voids that need filling. For example, there is a clear lack of educational materials for college students that specifically address groundwater pollution. The goal of this CD-ROM is to educate and help non-science majors make choices as decision-making adults that will protect groundwater. Relevance to all students is a key to this application. The work of this project is based on two respected educational theories, multiple intelligences theory (Gardner, 1983), and the ARCS theory of motivation (Keller, 1987).

The CD-ROM is a simulation of a conversation with a groundwater hydrologist who answers the student's questions about groundwater pollution issues. Students are placed in their own hypothetical futures as homeowners who use groundwater for drinking water. The information on the CD-ROM is divided into seven sections. Two introductory sections, *Groundwater Basics* and *Lab Reports*, help students understand background information for all groundwater pollution issues. Five separate issues, *Landfills*, *Septic Systems*, *Underground Storage Tanks*, *Fertilizers and Pesticides*, and *Karst Aquifers*, are covered in the CD-ROM. In each of the seven sections, students are prompted to ask specific, relevant questions about the lesson and about the subject matter. For example, the student may choose among the following questions from the landfills screen:

- What are the objectives of this section?
- What are landfills?
- What safeguards prevent groundwater pollution from landfills?
- What pollutants come from landfills and what are their health effects?
- What can I do to prevent groundwater pollution from landfills?
- What is my responsibility for groundwater pollution from landfills?

Educational theorists (Dick and Carey, 1996, for example) tell us that students need opportunities to practice new knowledge. They also tell us that students should review new skills and knowledge and transfer the knowledge to a new situation before leaving the learning experience. Therefore, students using the CD-ROM have two additional choices on each subject matter home screen:

- I want to practice.
- I want a coffee break to review and transfer.

Practice questions are clearly based on the learning objectives for the section. Multiple choice or short answer questions cover each objective. On multiple choice questions (Figure 2), students click the button beside the answer they choose. A bell or buzzer indicates whether their answer is correct. Then students can move their mouse over a button labeled "WHY" for an explanation of the correct answer. On short answer questions, students type their answers on a blank. When they have finished typing their answer, they move their mouse over a button labeled "CHECK" to compare their answer with the correct answer. Students can go through the practice as many times as they wish.

In the coffee break, students are encouraged to take a break from the CD-ROM to review their new skills and knowledge. Students are given a bulleted list of things to think about as they review. Then, students are encouraged to consider the groundwater pollution issue they just studied in a new perspective. For example, in the landfill section, students are asked to imagine that they are on the town council of a town whose landfill is filling up. "What will you have to consider about the people who drink groundwater and live near sites you propose?" the groundwater hydrologist asks. As shown in Figure 3, multimedia components are incorporated into the information presentation sections of the CD-ROM. Text, photographs, diagrams, videos, animations, and sounds are used to illustrate concepts in each section.

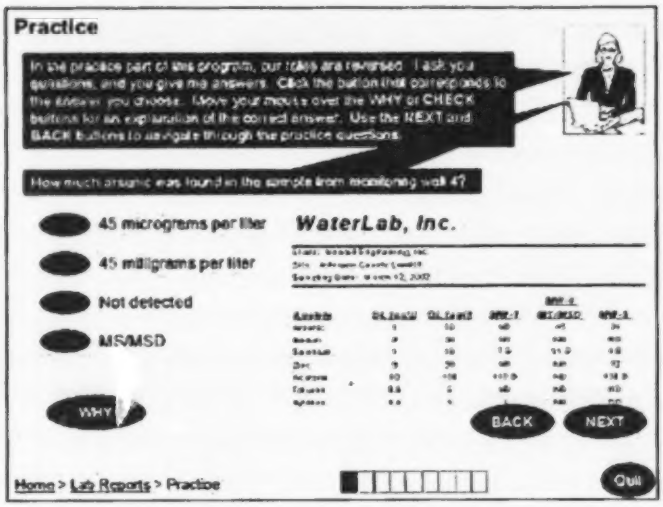

Figure 2: This screen is an example of a practice question from the Lab Reports section of the CD-ROM.

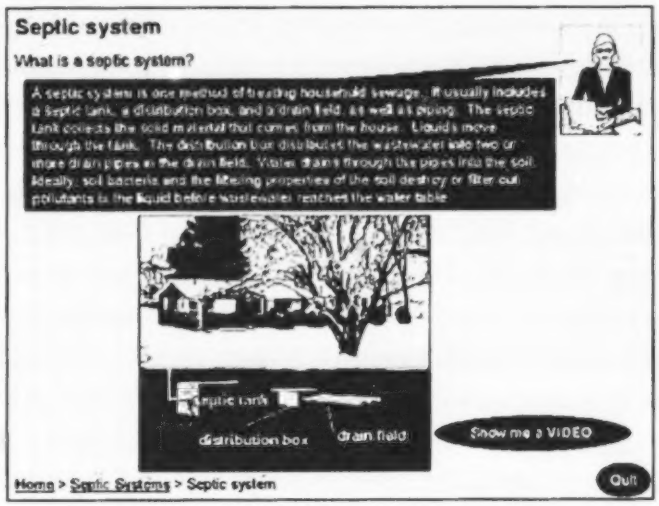

Figure 3: This screen from the septic systems section of the CD-ROM uses text, a diagram and photograph combined, and an illustration. The video button links to an animation showing how the septic system works.

Conclusion

It is our hope that sharing of such educational CD-ROM products will provide focus for other instructional technology users in their own multimedia projects. We also strongly feel the need to share work that has already been done so that the collective body of multimedia authors may continue moving forwards and charting new ground instead of expending efforts in re-inventing the wheel. Lastly we hope that insights into our multimedia design strategies and finished CD-ROMs empower other Earth Science educators in schools and colleges both within the United States and other nations to explore the feasibility of creating similar technologically advanced and pedagogically sound, customized teaching tools for use in their own classrooms.

References

Armstrong, T. (1994). Multiple Intelligences in the Classroom", *Association for Supervision and Curriculum Development*, Alexandria, Virginia, pp. 185

Butler, J. & Lamberson, M. (1998). Water where the grass is green. *Abstracts with Programs, Geological Society of America, v 30 (7)*, pp. 106.

Dick, W. and Carey, L. (1996). *The systematic design of instruction*. New York: Longman.

Gardner, H. (1983). *Frames of mind: The theory of multiple intelligences*. New York: BasicBooks.

Gardner, H. (1993). *Multiple Intelligences - The Theory in Practice*. New York: BasicBooks.

Grogger, P. (1999). The use of virtual geologic field trips and internet websites to facilitate earth science learning by students with disabilities. *Abstracts with Programs, Geological Society of America, v 31 (7)*, pp. 274.

Herrington, J. & Oliver, R. (1997). Multimedia, magic and the way students respond to a situated learning environment. *Australian Journal of Educational Technology, 13 (2)*, 127-143.

Keller, J. (1987). Development and use of the ARCS model of instructional design. *Journal of Instructional Development*, 10 (3), 2-10.

Lazear, D. (1991). *Seven Ways of Teaching - The Artistry of Teaching with Multiple Intelligences*. Illinois: IRI/Skylight Publishing Inc.

Levine, N. (1998). Successful internet augmented teaching in the geosciences at Bowling Green State University. *Abstracts with Programs, Geological Society of America, v 30 (7)*, pp. 346.

Powell, W. (2000). Using web-based bulletin boards to increase class discussion. *Journal of Geoscience Education, 48 (5)*, 602-603.

Prothero, W. (1996). Supporting critical thinking in the large general education oceanography class. *Abstracts with Programs, Geological Society of America, v 28 (7)*, pp. 164.

Rigsby, C. (1998). Using real-time internet discussion sessions in an upper division sedimentology course to promote focused discussion and build on concepts explored in activity-based projects. *Abstracts with Programs, Geological Society of America, v 30 (7)*, pp. 390.

Saini-Eidukat, B., Schwert, D. & Slator, B. (1998). Text-based implementation of the Geology Explorer, a multi-user role-playing virtual world to enhance learning of geological problem-solving. *Abstracts with Programs, Geological Society of America, v 30 (7)*, 390-391.

Sethi, P. (1998). From Conception to Completion: Core Competencies for Infusing Advanced CD-ROM Technologies in Geoscience Education. *Abstracts with Programs, Geological Society of America, v 30 (7)*, p. 347.

Sharma, S. & Hardcastle, J. (1999). Using multimedia to teach geotechnical engineering laboratory procedures. *Proceedings of the Symposium on Engineering Geology and Geotechnical Engineering, v 34*, 206-218.

Steele, M., Peers, E. & Moore, C. (1997). Access to geoscience data from the seafloor on the World Wide Web and on CD-ROM using Java (super tm) and WWW browser technology. *Annual Meeting Abstracts of the American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists, v 6*, pp. 111.

Wheeless-Gore, P. (1997). Using the world-wide web in the geology classroom. *Journal of Geoscience Education, 45 (3)*, 246-251.

U.S. Department of Education
Office of Educational Research and Improvement (OERI)
National Library of Education (NLE)
Educational Resources Information Center (ERIC)

NOTICE

Reproduction Basis

☒ This document is covered by a signed "Reproduction Release (Blanket)" form (on file within the ERIC system), encompassing all or classes of documents from its source organization and, therefore, does not require a "Specific Document" Release form.

☐ This document is Federally-funded, or carries its own permission to reproduce, or is otherwise in the public domain and, therefore, may be reproduced by ERIC without a signed Reproduction Release form (either "Specific Document" or "Blanket").